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**AN EURYPTERID HORIZON IN THE NIAGARA
FORMATION OF ONTARIO**

by

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An Eurypterid Horizon in the Niagara Formation of Ontario.

By M. Y. WILLIAMS.

GENERAL STRATIGRAPHY.

The top of the Lockport member of the Niagara formation of Ontario consists of thin-bedded dark grey or chocolate brown bituminous dolomites which at some localities include bituminous shales. In some districts the cleavage along bedding planes is exceedingly even and slabs may be obtained that suggest roofing slates. Flagstones are quarried from such beds near Wiarton. At other localities the bedding is uneven, though thin. These characteristic beds are well exposed along the banks of the Eramosa river between Rockwood and Guelph, and for them the name "Eramosa beds" is proposed. Sir William Logan¹ described the Guelph dolomites in the vicinity of Guelph as resting "upon dark coloured bituminous strata" which he placed in the Niagara formation. His reference was under discussion.

The Eramosa beds are very uniform in their general character. At the north end of the Bruce peninsula they are 30 feet thick; at Wiarton, they measure over 40 feet; at Guelph, 30 feet or more; and at Spencer creek, 7 miles west of Hamilton, more than 35 feet. South of Hamilton, the highest of the dark slaty beds, known locally as the "Barton beds," are probably the equivalent of the Eramosa. The Barton beds

¹ Geol. Surv. of Can., Report of Progress, from its commencement to 1863, p. 337.

are about 70 feet thick, consist of thin to thick-bedded dolomite with interbedded shale, and contain numerous Niagara fossils. Except in the vicinity of Hamilton and Guelph, the Eramosa beds appear to be unfossiliferous.

The Guelph formation rests conformably upon the Eramosa dolomites, the contact being transitional and the lower Guelph beds being quite bituminous at many of the southern localities. The Guelph beds are, however, usually 1 to 2 feet thick.

Where well exposed, the Eramosa beds exhibit beautifully symmetrical domes 100 to 200 feet across with centres rising 15 to 20 feet above the rim. Along the north shore of the Bruce peninsula such domes are common. In the eastern part of the city of Guelph, a well developed dome has been left in the floor of a quarry. This is at the top of the Eramosa beds. South of the prison farm near the Eramosa river, a coral reef rises through Eramosa beds which have been eroded from its top but still flank its sides. The reef is 35 yards wide by 85 yards long and rises about 20 feet at the centre. Some irregular bedding shows at one end. The following fossils were found in the reef material: *Stromatoporoids*, *Omphyma stockesi* Edwards and Haime, *Pycnostylus guelphensis* Whiteaves, *P. elegans* Whiteaves, *Favosites kisingeri* Edwards and Haime, *Cladopora* sp., *Heliolites spinopora* Hall? *Bryozoa*, *Rhynchotrete cuneata americana* Hall?, *Camarotoechia neglecta* (Hall), and a trilobite pygidium.

This fauna is in the main typically Lockport, but the presence of the two species of *Pycnostylus*, which are among the most typical of Guelph species, indicates that in this old reef transitional conditions existed. The reef explains the origin of one mound which formerly existed in the Eramosa beds.

LOCATION AND OCCURRENCE OF THE EURYPTERID FAUNA.

East of Guelph at the crossing of the Canadian Pacific and Canadian Northern tracks and not far south of the Eramosa river, the Canadian Northern road bed has been constructed of chocolate brown, bituminous shales excavated from the right of way. It is these shales that furnished the fauna here described.

The depth of excavation was 3 to 4 feet, the fauna being entirely confined to this horizon. Fragmentary fossils were also found in place and it appeared that most of the remains were contained in about 6 inches of strata. The horizon is about 25 feet below the base of the Guelph formation.

THE FAUNA.

The following species were found at the above described locality. *Lichenalia concentrica* Hall, *Monomorella* cf. *orbicularis* Billings, *Orbiculoidea subplana* (Hall), *Orthis*? near *tenuidens* Hall, *Camarotoechia whitei* (Hall)?, *Spirifer radiatus* Sowerby?, *Whitfieldella nitida* Hall?, *Anoplothea*? sp., *Meristina*? sp., *Conularia niagarensis* Hall?, *Conularia* sp., *Eusarcus logani* sp. nov. Some other poorly preserved fossil material was found, which has not been identified. Some fragments appear to be crinoid columns.

Not only are the fossils all from the same horizon, but numerous *Orbiculoidea* occur on the same slabs with *Eusarcus* fragments and also resting upon *Eusarcus* telsons.

FAUNAL AFFINITIES.

From the occurrence of the genus *Eusarcus* in the fauna of the Eramosa beds we are led to compare this fauna with others also including *Eusarcus*. Three Silurian horizons have furnished this genus, viz., the Bertie¹ waterlime of New York and Ontario, the Kokomo² waterlime of Indiana, and the shale beds of the Shawangunk³ grit of eastern New York. The Bertie waterlime and Shawangunk grit possess only crustacean faunas, and as *Eusarcus logani* is quite unlike species found in them it is consequently difficult to make comparisons. In the case of the Kokomo⁴ waterlime of Indiana, it is different. *Eusarcus newlini* of that horizon is perhaps more closely related to *E. logani*

¹ Pohlman, Julius, Buffalo Soc. Nat. Sci., Bull. 5, 23, 1886.

² Claypole, E. W., Am. Geol., Vol. VI, pp. 258-260, 1890.

³ Clarke, J. M., and Ruedemann, Rudolf, N.Y. State Mus. Bull. 107, p. 295.

⁴ The Age of the Kokomo according to Clarke and Ruedemann is Lockport: N.Y. State Museum Memoir 14, 1912, Vol. I, p. 87. Kindle, however, concludes that it is "either a Salina or Cobleskill horizon." Am. Jour. Science, Vol. XXXVI, Sept., 1913, p. 288.

than any of the other species and the fauna in the limestone immediately above the eurypterid beds contains a number of brachiopods of which two genera are in common with the fauna of the Eramosa beds. The Kokomo contains *Whitfieldella erecta* Foerste and *Anoplothea congregata* Kindle; the Eramosa, *W. nitida* Hall, and *Anoplothea*? sp.

Leaving out of account the eurypterids, the Eramosa fauna is related as follows: *Orthis* near *tenuidens* suggests Clinton affinities; *Whitfieldella nitida* and *Conularia niagarensis* are Rochester species; *Lichenalia concentrica* and *Spirifer radiatus* are characteristic of the Rochester and lower Lockport; and *Camarotoechia whitei* is a true Lockport species; *Monomorella orbicularis*, with which I have compared the Eramosa species, is typically Guelph.

Summing up, in the Eramosa shale beds at the top of the Lockport, there is a recurrence of a part of the fauna characteristic of the Rochester shale, with even a suggestion of a Clinton type, these hold-overs being mingled with more typical Lockport species and one forerunner of the characteristic Guelph fauna. Thus, we have very good palæontological evidence of the conformable relations of the Niagara and Guelph formations. The coral reef, occurring in the Eramosa beds, as already described above, contains additional evidence in its mingled Lockport and Guelph species that the eurypterid fauna lived at a period of transition between Lockport and Guelph time. The preponderance of the earlier elements, however, makes it seem advisable to class the Eramosa beds, as has formerly been done, with the Lockport rather than the Guelph.

Discussion has formerly arisen as to the habitat of the eurypterids and examples are rare where eurypterids and well established marine species occur in the same beds. That in this case the eurypterids lived in an entirely marine habitat is shown by the associated fauna.

DESCRIPTION OF SPECIES.

Lichenalia concentrica Hall.

Plate I, figure 1.

Specimens fragmentary; surface generally undulatory; radial and concentric striae about 0.5 mm. apart. In both sets of striae there is a tendency for some of the furrows to be much stronger than others.

From the above described characters, there appears to be little doubt that this is *L. concentrica*, described by Hall from the Rochester shale and lower Lockport limestone at Rochester and Lockport, New York.

Monomorella cf. *orbicularis* Billings.

Plate I, figure 2.

One specimen, which I have compared with the above species, occurs in the collection. It is 26 mm. wide and 27 mm. long, the shape being suborbicular with the greatest width forward of the centre of the shell. The specimen is an exfoliated pedicle valve. The growth lines are well preserved, but the interior structure is not visible except at the beak, where wear has exposed the median septum and the fillings of the ends of the umbonal chambers. I have compared this specimen with Billings type (internal mould) of *M. orbicularis* and find much similarity. However, the preservation of the two specimens is so entirely different that it is very difficult to be certain of their identity. I have noted some differences in the proportions of the umbonal cavities as represented in the two specimens and I have consequently compared the present specimen with *M. orbicularis* instead of making a definite determination.

Orbiculoidea subplana (Hall).

Plate I, figures 3, 4, 5.

This species, which is represented by many individuals, is suborbicular with axes averaging about 5 and 8 mm. Valves

compressed; apex sub-central; pedicle groove narrow, extending about one-half the distance or less from the apex to the margin of the shell; lamellæ erect and numbering seventeen to twenty in the average specimen.

These specimens are less than one-half the size of specimens from Arisaig, N.S. The latter specimens are also much more convex and tend to have a more elliptical outline and coarser lamellæ, the number of which are about the same as in the specimens here described. The Arisaig specimens occur in limestone and it is thought that the differences between them and the above may be due to habitat, and in part to pressure.

Orthis? near *tenuidens* Hall.

Plate I, figure 6.

Small, averaging about 7 mm. wide and 4.5 mm. long. Hinge line straight, nearly as long as the width of the shell. Brachial valve somewhat concave, with a slight median depression and probably a slight convexity near the beak. Plications rounded; incurved from the cardinal angles; increasing by implantation; number about 40. Pedicle valve convex. Characters poorly preserved in material at hand.

This species appears to be very near if not identical with Hall's *O. tenuidens* from the Clinton of Oneida county, N.Y.

Camarotoechia whitei (Hall) ?

The presence of this species is based on one badly crushed specimen. Its size, shape, and characters of plications all point to this being the same as Hall's species from the Niagara of New York.

Spirifer radiatus Sowerby ?

Plate II, figure 1.

The specimens referred to this species are casts of interiors of pedicle valves and are small, the largest being less than 10 mm. in length. The casts show clearly the impressions made by the long dental plates.

Whitfieldella nitida Hall?

Plate II, figure 2, numerous small specimens.

Small whitfieldellas are very common in some layers of rock; they are generally less than 5 mm. long, vary considerably in proportion of length to width, and have sharp erect beaks. In all characters excepting the erect beak, this little whitfieldella appears to be clearly referable to the species *nitida*.

Meristina? sp.

Plate II, figure 2, single large specimen.

A single poorly preserved pedicle valve 12 mm. long by 9 mm. wide with a well-defined sinus from beak to front is doubtfully referred to this genus.

Anoplotheca? sp.

Plate II, figure 3.

A single mould of what appears to be a pedicle valve of a shell doubtfully referable to this genus, measures 14 mm. in breadth and 15 mm. in length. The convexity was never great, and was probably most marked about the middle of the shell. Crushing has reduced the convexity. The shape is nearly circular, excepting for the beak which protrudes slightly. The apical angle is about 115 degrees. The plications are straight, subangular, and number eighteen. They increase towards the margin by bifurcation.

Conularia niagarensis Hall?

Plate II, figure 4.

One specimen appears to represent this species. It is 5 cm. long by 3.2 cm. wide, and tapers rather abruptly towards the apical end. So far as they are preserved, the characters of this specimen agree closely with the figures given by Hall (Palæontology of New York, Vol. II, Pl. 65). The transverse

striae, however, are grouped in bundles separated by deeper furrows, thus giving the surface a decided rugose appearance. The character of the surface integument cannot be determined, owing to the poor state of preservation.

Conularia ? sp.

Plate II, figure 5.

One specimen is doubtfully referred to this genus. From the apex it broadens greatly, having a width of 4 cm. at a length of 5 cm. along the mid-line. The sides approximate converging arcs of eccentric circles. The concentric plates are a little more than 1 mm. wide, overlap consecutively away from the apex, are longitudinally striated, and appear to be crossed by transverse striae. The general shape of the specimen and the lack of reflex curve in the plications so characteristic of *Conularia*, make it appear uncertain whether after all it belongs in this genus.

*Eusarcus logani*¹ sp. nov.

Plate III, figures 2-6; Plate IV, figures 1, 2; Plate V, figures 1-5.

The above species is described from the following fragments: post-abdominal segments; telsons; spines from the ectognathites or walking legs; manducatory edges of the gnathobases of the swimming legs; and a metastoma.

The post-abdominal segments appear to be 5 in number and measure together, in the best preserved specimen, 3 cm. in length. At the attachment with the abdomen (the posterior segment of which is slightly indicated) the width is 1.8 cm. The terminal post-abdominal segment measures 1.1 cm. in width and has two lateral, posteriorly directed processes between which the telson was attached. The surface integument is covered with fine pits.

The *telsons* are ensiform, straight, and from 5.5 to 8 cm. long, with a proximal width of 8-11 mm. They are crushed

¹ Named in honour of Sir Wm. Logan who described the beds in which the fossils were found. Geol. Surv. of Canada, 1863, p. 337.

and (probably from this cause) have two longitudinal grooves dividing the area into three parts, the centre containing one-half and the sides each one-quarter of the total area. The proximal ends of some specimens are enlarged and rounded, indicating a well formed joint with the distal, post-abdominal segment.

The *spines* from the ectognathites or walking legs measure 1.7 to 3.5 cm. in length, 0.35 to 0.5 cm. in width at mid-length, and 0.4 to 0.6 cm. in width at the joint.

These spines are nearly straight, the thicker edge being convex and projecting slightly beyond the thinner edge, which is gently convex near the proximal end and resupinate near the point. In one specimen the joint is considerably enlarged and thickened. The spines, although crushed to some extent, appear to have been very thin.

The *manducatory edges* of the gnathobases of the swimming legs occur plentifully and in a fair state of preservation. The rows of teeth measure nearly 1 cm. in length and are made up of 5-6 conical cusps which vary from 2.5 mm. at one end of the row to less than 1 mm. at the other end. Both the line through the bases of the cusps and the line along their crests are concave.

The *metastoma* is represented by a fragmentary plate which, however, shows the "broad and short, subtriangular" shape characteristic of *Eusarcus*. At its widest part, it is 1.1 cm. and at the narrowest part 0.8 cm. wide, the fragment being 0.8 cm. long.

Other plates occur which have not been identified with certainty. Their surfaces are covered with fine pits.

I have referred this species to the genus *Eusarcus* on the following evidence: the broad, short, subtriangular shape of the metastoma; the number and large size of the spines of the walking legs; and the indicated enlargement of the abdomen.

Logani differs from other species of *Eusarcus* in the proportionately great size of the spines and telson. From *E. scorpionis* this species differs also in having a straight ensiform telson.

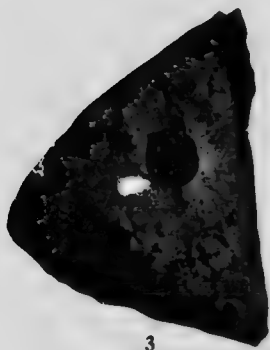
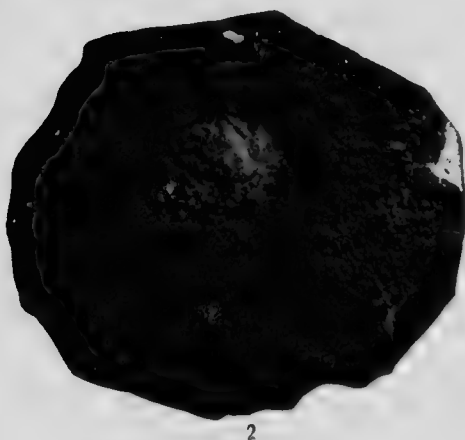
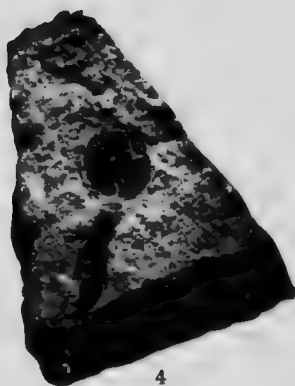
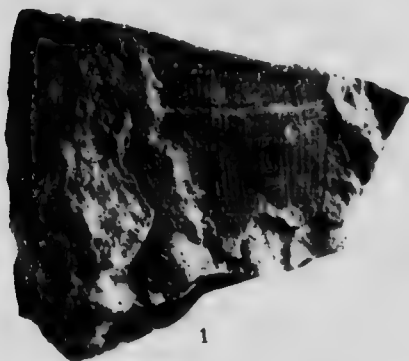




EXPLANATION OF PLATE I.

- Figure 1. *Lichenalia concentrica* Hall. (Page 5.)
 2. *Monomorella cf. orbicularis* Billings.
 Exfoliated and partly worn pedicle valve. (Page 5.)
 " 3 and 4. *Orbiculoidea subplana* (Hall)?
 Pedicle? valves. (Page 5.)
 " 5. *Orbiculoidea subplana* (Hall)?
 On telson of *Eusarcus logani*. (Page 5.)
 " 6. *Orthis?* near *tenuidens* Hall.
 Brachial valve. (Page 6.)

Illustrations natural size.



EXPLANATION OF PLATE II.

- Figure 1. *Spirifer radiatus* Sowerby?
Cast of interior of pedicle valve. (Page 6.)
- " 2. *Meristina*? sp.
Pedicle valve, single large specimen.
Whitfieldella nitida Hall?
Numerous small specimens in same figure. (Page 7.)
- " 3. *Anoplothea*? sp.
Mould of pedicle valve. (Page 7.)
- " 4. *Conularia niagarensis* Hall? (Page 7.)
- " 5. *Conularia*? sp.
Interior of shell. (Page 8.)

Illustrations natural size.



EXPLANATION OF PLATE III.

Figure 1. Undetermined.

- " 2. Metastoma of *Eusarcus logani*. (Page 9.)
- " 3 and 4. Manducatory edges of gnathobases of swimming legs of *Eusarcus logani*. (Page 9.)
- " 5. Spine from ectognathite and probable remains of ectognathite of *Eusarcus logani*. (Page 9.)
- " 6. Telson of *Eusarcus logani*. (Page 8.)

Illustrations natural size.



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2



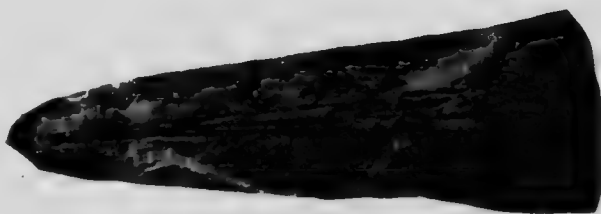
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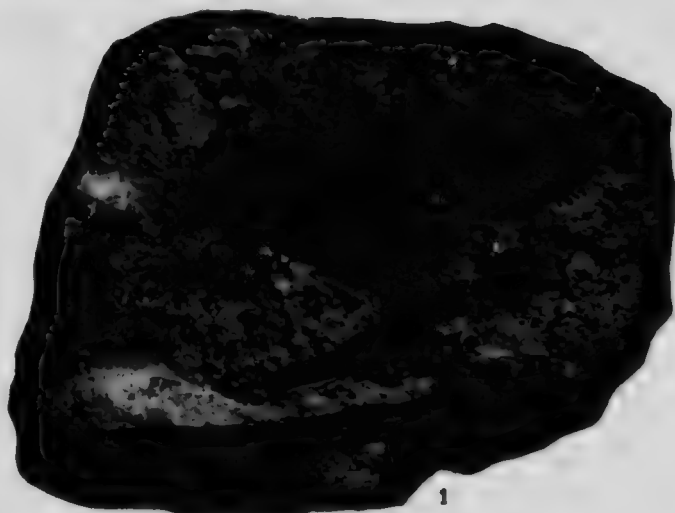


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EXPLANATION OF PLATE IV.

- Figure 1. Body plates, telson, and spine from ectognathite of *Eusarcus logani*.
(Page 9.)
2. Post-abdominal segments of *Eusarcus logani*. (Page 8.)

Illustrations natural size.



1



2

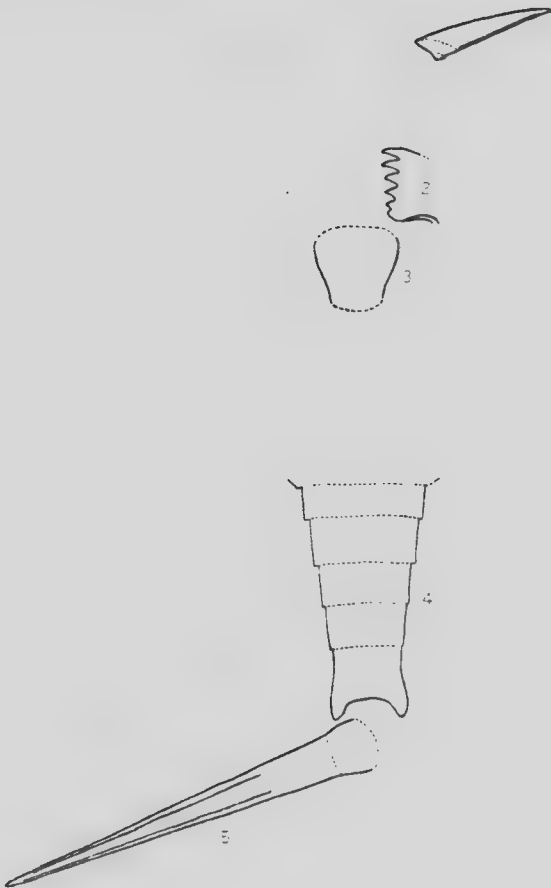
logani.

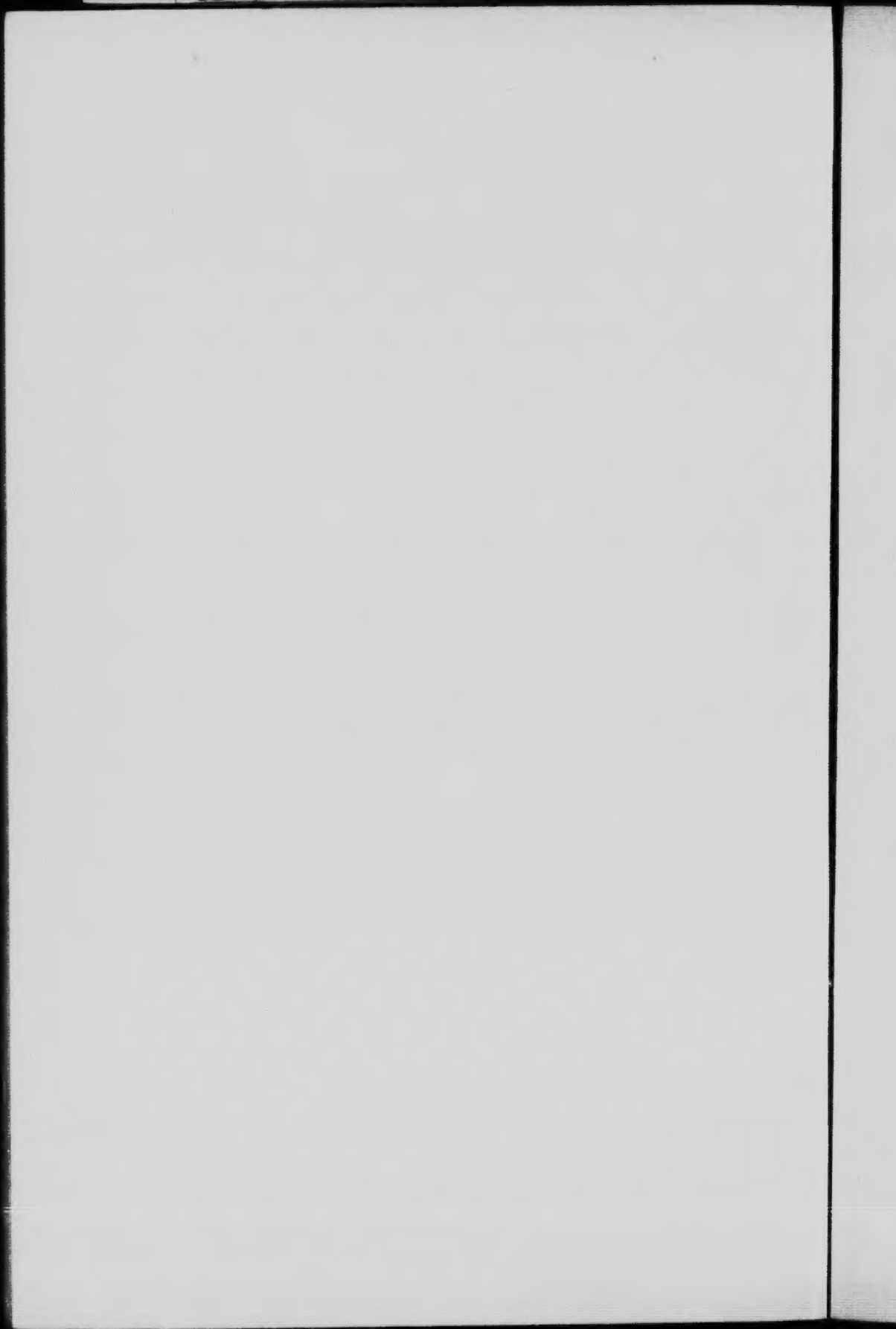
EXPLANATION OF PLATE V.

Eusarcus logani sp. nov.; (Page 8.)
Parts partially restored by the author.

- Figure 1. One of the smaller spines from the ectognathites or walking legs.
" 2. Manducatory edge of gnathobase of a swimming leg.
" 3. Restored Metastoma.
" 4. Post-abdominal segments restored.
" 5. Side view of a compressed telson.

Illustrations natural size.





LIST OF MUSEUM BULLETINS.

The Museum Bulletins, published by the Geological Survey, are numbered consecutively and are given a series number in addition, thus: Geological Series No. 1, 2, 3, etc.; Biological Series No. 1, 2, 3, etc.; Anthropological Series No. 1, 2, 3, etc.

In the case of Bulletins 1 and 2, which contain articles on various subjects, each article has been assigned a separate series number.

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- MUS. BULL. 19. *Anthrop. Ser. 7.* A sketch of the social organization of the Nass River Indians—by E. Sapir.
- MUS. BULL. 20. *Geol. Ser. 29.* An Eurypterid horizon in the Niagara formation of Ontario—by M. Y. Williams.

